CLAIMS

1.   A liquid treatment apparatus for performing a liquid treatment to process objects, comprising:

a process bath adapted to contain a process liquid and a process object therein;

a plurality of process liquid supply nozzles arranged at different levels beside the process objects in the process bath, each of the nozzles having a discharge port directed toward the process object contained in the process bath;

a plurality of process liquid supply valves adapted to control a supply of the process liquid from a process liquid supply source to the process liquid supply nozzles; and

a sequence controller configured to control operations of the process liquid supply valves according to a predetermined sequence of operations, so that one or more process liquid supply nozzles selected from said plurality of process liquid supply nozzles discharge the process liquid in each of a plurality of process liquid supply periods, and that, a process liquid supply condition of at least one of said plurality of process liquid supply nozzles in each of the process liquid supply periods is different from that in an immediately preceding process liquid supply period.

2.   The liquid treatment apparatus according to claim 1, wherein said plurality of process liquid supply nozzles are divided into a first group and a second group, the process liquid supply nozzles belonging to the first group are arranged at different levels on one side of the process object, and the process liquid supply nozzles belonging to the second group are arranged at different levels on another side of the process object.

3.   The liquid treatment apparatus according to claim 2, wherein said plurality of process liquid supply nozzles are arranged so that the first group includes process liquid supply

nozzles each located at a level corresponding to that of each of the process liquid supply nozzles belonging to the second group.

4.   The liquid treatment apparatus according to claim 3, wherein:

the liquid treatment is a treatment that treats the process object with a chemical liquid as the process liquid; and

the controller is configured to control the process liquid supply valves so that one of the process liquid supply nozzles of the first group and one of the process liquid supply nozzles of the second group, which are arranged at the same level, simultaneously discharge the process liquid at least in a part of said plurality of process liquid supply periods.

5.   The liquid treatment apparatus according to claim 3, wherein:

the liquid treatment is a treatment that treats the process object with a chemical liquid as the process liquid; and

the controller is configured to control the process liquid supply valves so that the following conditions are alternately achieved repeatedly at least in a part of said plurality of process liquid supply periods: a condition in which one of the process liquid supply nozzles belonging to the first group discharges the chemical liquid while the process liquid supply nozzle belonging to the second group arranged at a level corresponding to that of said one of the process liquid supply nozzles belonging to the first group does not discharge the chemical liquid; and a condition in which one of the process liquid supply nozzles belonging to the second group discharges the chemical liquid while the process liquid supply nozzle belonging to the first group arranged at a level corresponding to that of said one of the process liquid supply nozzles belonging to the second group does not discharge the chemical liquid.

6.   The liquid treatment apparatus according to claim 1, wherein:

the liquid treatment is a treatment that treats the process object with a rinse liquid as the process liquid; and

the controller is configured to control the process liquid supply valves so that a lowermost one of said plurality of process liquid supply nozzles arranged at different levels discharges the rinse liquid, and thereafter the lowermost process liquid supply nozzle and at least one of process liquid supply nozzles selected from the process liquid supply nozzles other than the lowermost process liquid supply nozzle discharge the rinse liquid.

7.   The liquid treatment apparatus according to claim 6, wherein the controller is configured to control the process liquid supply valves so that the lowermost process liquid supply nozzle discharges the rinse liquid, and thereafter all the process liquid supply nozzles discharge the rinse liquid.

8.   The liquid treatment apparatus according to claim 3, wherein:

the liquid treatment is a treatment that treats the process object with a rinse liquid as the process liquid; and

the controller is configured to control the process liquid supply valves so that, at least in one of said plurality of process liquid supply periods, one of the process liquid supply nozzles belonging to the first group discharges the chemical liquid while the process liquid supply nozzle belonging to the second group arranged at a level corresponding to that of said one of the process liquid supply nozzles belonging to the first group does not discharge the chemical liquid.

9.   The liquid treatment apparatus according to claim 1, wherein:

the liquid treatment is a treatment that treats the process object with a chemical liquid diluted with a rinse liquid, as the process liquid;

the process liquid supply source includes a chemical

liquid supply source and a rinse liquid supply source;

a chemical liquid supply line connected to the chemical liquid supply source merges into a process liquid supply line, which connects the rinse liquid supply source to the process liquid supply nozzles;

the chemical liquid supply line is provided with a flow control device adapted to control a flow rate of the chemical liquid flowing from the chemical liquid supply line into the process liquid supply line; and

the controller is configured to control the flow control device depending on a flow rate of the process liquid being supplied to the process liquid supply nozzles through the process liquid supply line so that a concentration of a chemical component in the process liquid is maintained substantially constant.

10.   The liquid treatment apparatus according to claim 9, wherein:

the controller is configured to control the process liquid supply valves so that the number of the process liquid supply nozzles discharging the process liquid in one of the process liquid supply periods is different from that of the process liquid supply nozzles discharging the process liquid in another process liquid supply period following said one of the process liquid supply periods; and

the controller is also configured to control the flow control device depending on the number of the process liquid supply nozzles discharging the process liquid, so that the concentration of the chemical component in the process liquid flowing through the process liquid supply line in said one of the process liquid supply periods is identical to that in said another process liquid supply period.

11.   The liquid treatment apparatus according to claim 9, wherein the flow control device is adapted to shut off a flow of the chemical liquid from the chemical liquid supply line into the

process liquid supply line, thereby allowing said apparatus to selectively perform the liquid treatment using the chemical liquid diluted with the rinse liquid, or a liquid treatment using only the rinse liquid.

12. A liquid treatment method comprising the steps of:

discharging a process liquid from one or more process liquid supply nozzles selected from a plurality of process liquid supply nozzles arranged in a process bath, each of the nozzles having a discharge port directed toward a process object contained in the process bath; and

thereafter changing a process liquid discharge condition of at least one of said plurality of process liquid supply nozzles.

13. The liquid treatment method according to claim 12, wherein the process liquid supply nozzles arranged at different levels discharge the process liquid in different process liquid discharge periods.

14. The liquid treatment method according to claim 12, wherein a process liquid supply nozzle arranged on one side of the process object discharges the process liquid, and thereafter a process liquid supply nozzle arranged another side of the process object discharges the process liquid.

15. A liquid treatment method comprising the steps of:

performing a chemical liquid treatment by immersing a process object in a process bath containing a chemical liquid; and

performing a rinse liquid treatment that rinses the process object and replaces the chemical liquid with the rinse liquid,

wherein the rinse liquid treatment includes the steps of:

discharging the rinse liquid from one or more process liquid supply nozzles selected from a plurality of process liquid supply nozzles arranged in a process bath, each of the nozzles

having a discharge port directed toward the process object contained in the process bath; and

thereafter changing a rinse-liquid discharge condition of at least one of said plurality of process liquid supply nozzles.

16. The liquid treatment method according to claim 15, wherein, in a time period when the rinse liquid treatment is performed, both a process liquid supply nozzle arranged on one side of the process object and a process liquid supply nozzle arranged on another side of the process object discharge the rinse liquid.

17. The liquid treatment method according to claim 15, wherein, in the rinse liquid treatment, the lowermost one of said plurality of process liquid supply nozzles discharges the rinse liquid, and thereafter all of said plurality of process liquid supply nozzles discharge the rinse liquid.

18. The liquid treatment method according to claim 15, wherein, in the rinse liquid treatment, all of said plurality of process liquid supply nozzles discharge the rinse liquid, thereafter the lowermost one of said plurality of process liquid supply nozzles discharges the rinse liquid, and thereafter all of said plurality of process liquid supply nozzles discharge the rinse liquid.

19. A storage medium storing a software executable by a control computer of a liquid treatment apparatus, wherein the control computer controls the liquid treatment apparatus to perform a liquid treatment method upon execution of the software,

wherein the liquid treatment method is defined by any one of claims 12 to 18.